Package 'greeks'

August 6, 2021

Title Sensitivities of Prices of Financial Options

Version 0.3.1

Description Methods to calculate sensitivities of financial option prices for European and Asian and American options in the Black Scholes model. Classical formulas are implemented for European options in the Black Scholes Model, as is presented in Hull, J. C. (2017). Options, Futures, and Other Derivatives, Global Edition (9th Edition). Pearson. In the case of Asian options, Malliavin Monte Carlo Greeks are implemented, see Hudde, A. & Rüschendorf, L. (2016). European and Asian Greeks for exponential Lévy processes. <arXiv:1603.00920>. For American options, the Binomial Tree Method is implemented, see also as is presented in Hull, J. C. (2017).

License MIT + file LICENSE

Encoding UTF-8

RoxygenNote 7.1.1

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

Imports magrittr, matrixStats, dqrng, Rcpp

LinkingTo Rcpp

NeedsCompilation yes

Author Anselm Hudde [aut, cre] (<https://orcid.org/0000-0002-5652-2815>)

Maintainer Anselm Hudde <anselmhudde@gmx.de>

Repository CRAN

Date/Publication 2021-08-06 05:00:16 UTC

R topics documented:

`Binomial_American_Greeks` *Computes the Greeks of an American call- or put-option with the Binomial options pricing model*

Description

Computes the Greeks of an American call- or put-option with the Binomial options pricing model

Usage

```
Binomial_American_Greeks(
  initial_price = 100,
  exercise_price = 100,
  r = 0,
  time_to_maturity = 1,
  volatility = 0.3,
  dividend_yield = 0,
  payoff = "call",
  greek = c("fair_value", "delta", "vega", "theta", "rho", "epsilon", "gamma"),
  steps = 1000,
  eps = 1/10000
)
```

Arguments

`initial_price`	• initial price of the underlying asset.
`exercise_price`	• strike price of the option.
`r`	• risk-free interest rate.
`time_to_maturity`	• time to maturity.
`volatility`	• volatility of the underlying asset.
`dividend_yield`	• dividend yield.
`payoff`	• the payoff function, a string in ("call", "put").
`greek`	• the Greek to be calculated.
`steps`	• the number of integration steps.
`eps`	• the step size for the finite difference method to calculate theta, vega, rho and epsilon

Value

Named vector containing the values of the Greeks specified in the parameter `greek`.

Examples

```
Binomial_American_Greeks(initial_price = 100, exercise_price = 100,
r = 0, time_to_maturity = 1, volatility = 0.3, dividend_yield = 0,
payoff = "call", greek = c("fair_value", "delta", "vega", "theta", "rho",
"epsilon", "gamma"), steps = 20)
```

BS_European_Greeks *Computes the greeks of an European call- or put-option in the Black Scholes model*

Description

Computes the greeks of an European call- or put-option in the Black Scholes model

Usage

```
BS_European_Greeks(
  initial_price = 100,
  exercise_price = 100,
  r = 0,
  time_to_maturity = 1,
  volatility = 0.3,
  dividend_yield = 0,
  payoff = "call",
  greek = c("fair_value", "delta", "vega", "theta", "rho", "epsilon", "lambda",
    "gamma", "vanna")
)
```

Arguments

`initial_price`	• initial price of the underlying asset
`exercise_price`	• strike price of the option
`r`	• risk-free interest rate
`time_to_maturity`	• time to maturity
`volatility`	• volatility of the underlying asset
`dividend_yield`	• dividend yield
`payoff`	• in c("call", "put")
`greek`	• greeks to be calculated in c("fair_value", "delta", "vega", "theta", "rho", "epsilon", "lambda", "gamma", "vanna")

Value

Named vector containing the values of the greeks specified in the parameter `greek`.

Examples

```
BS_European_Greeks(initial_price = 120, exercise_price = 100,
r = 0.02, time_to_maturity = 4.5, dividend_yield = 0.015, volatility = 0.22,
greek = c("fair_value", "delta", "gamma"), payoff = "put")
```

`Malliavin_Asian_Greeks` *Computes the Greeks of an Asian option with the Malliavin Monte Carlo Method in the Black Scholes model*

Description

Computes the Greeks of an Asian option with the Malliavin Monte Carlo Method in the Black Scholes model

Usage

```
Malliavin_Asian_Greeks(
  initial_price = 100,
  exercise_price = 100,
  r = 0,
  time_to_maturity = 1,
  volatility = 0.3,
  dividend_yield = 0,
  payoff = "call",
  greek = c("fair_value", "delta", "rho", "vega", "theta", "gamma"),
  model = "black_scholes",
  lambda = 0.2,
  alpha = 0.3,
  jump_distribution = function(n) stats::rt(n, df = 3),
  steps = round(time_to_maturity * 252),
  paths = 10000,
  seed = 1,
  antithetic = FALSE
)
```

Arguments

`initial_price`	• initial price of the underlying asset.
`exercise_price`	• strike price of the option.
`r`	• risk-free interest rate.
`time_to_maturity`	• time to maturity.
`volatility`	• volatility of the underlying asset.
`dividend_yield`	• dividend yield.

payoff	• the payoff function, either a string in ("call", "put", "digital_call", "digital_put"), or a function.
greek	• the Greek to be calculated.
model	• the model to be chosen in ("black_scholes", "jump_diffusion")
lambda	• the lambda of the Poisson process in the jump-diffusion model
alpha	• the alpha in the jump-diffusion model influences the jump size
jump_distribution	• the distribution of the jumps, choose a function which generates random numbers with the desired distribution
steps	• the number of integration steps.
paths	• the number of simulated paths.
seed	• the seed of the random number generator
antithetic	• if TRUE, antithetic random numbers will be chosen to decrease variance

Value

Named vector containing the values of the Greeks specified in the parameter `greek`.

Examples

```
Malliavin_Asian_Greeks(initial_price = 110, exercise_price = 100,
r = 0.02, time_to_maturity = 4.5, dividend_yield = 0.015, volatility = 0.22,
greek = c("fair_value", "delta", "rho"), payoff = "put")
```

Malliavin_European_Greeks

Computes the Greeks of an European option with the Malliavin Monte Carlo Method in the Black Scholes model

---

Description

Computes the Greeks of an European option with the Malliavin Monte Carlo Method in the Black Scholes model

Usage

```
Malliavin_European_Greeks(
  initial_price = 100,
  exercise_price = 100,
  r = 0,
  time_to_maturity = 1,
  volatility = 0.3,
  dividend_yield = 0,
  payoff = "call",
```

```
  greek = c("fair_value", "delta", "vega", "theta", "rho", "gamma"),
  model = "Black Scholes",
  paths = 10000,
  seed = 1,
  antithetic = FALSE
)
```

Arguments

initial_price	• initial price of the underlying asset.
exercise_price	• strike price of the option.
r	• risk-free interest rate.
time_to_maturity	• time to maturity.
volatility	• volatility of the underlying asset.
dividend_yield	• dividend yield.
payoff	• the payoff function, either a string in ("call", "put", "digital_call", "digital_put"), or a function.
greek	• the greek to be calculated.
model	• the model to be chosen.
paths	• the number of simulated paths.
seed	• the seed of the random number generator
antithetic	• if TRUE, antithetic random numbers will be chosen to decrease variance

Value

Named vector containing the values of the Greeks specified in the parameter greek.

Examples

```
Malliavin_European_Greeks(initial_price = 110, exercise_price = 100,
r = 0.02, time_to_maturity = 4.5, dividend_yield = 0.015, volatility = 0.22,
greek = c("fair_value", "delta", "rho"), payoff = "put")
```

Index